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ROADSIDE REVEGETATION IN MONTANA

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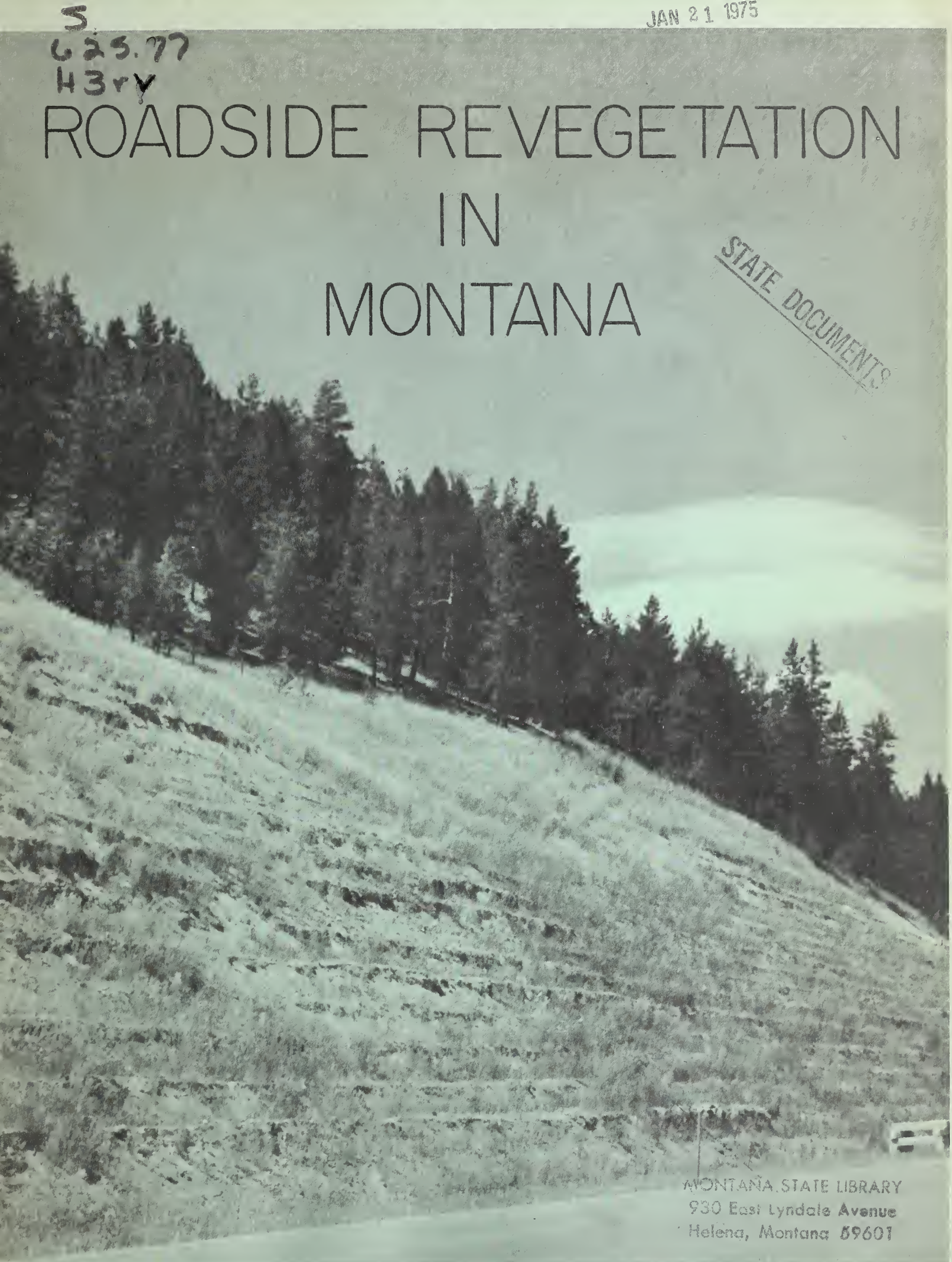

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STATE OF MONTANA
DEPARTMENT OF HIGHWAYS

HELENA, MONTANA 59601

H. J. ANDERSON
DIRECTOR OF HIGHWAYS

January 6, 1975

33-REH
IN REPLY REFER TO:

Senator W. Gordon McOmber, President of the Senate
Representative Pat McKittrick, Speaker of the House
Forty-Fifth Legislative Assembly
Helena, Montana 59601

Dear Messrs. McOmber and McKittrick:

Pursuant to Senate Joint Resolution 55 enacted by the 44th Legislative Assembly, transmitted herewith are two colored editions of "Roadside Revegetation In Montana." Colored editions have also been supplied to the Governor, the Montana State Highway Commission, and Legislative Council. Black and white editions are being supplied to all members of the House and Senate on this date. A limited number is also available to the public upon request.

I would hope that interested Legislators review the colored editions available through the Legislative Council, as these reproductions offer a more realistic visual assessment. I will be available at your convenience to discuss any further questions concerning the revegetation practices of the Department of Highways.

Sincerely,

H.J. ANDERSON
DIRECTOR OF HIGHWAYS

33-HJA/REH/lkl

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PREPARED BY THE

STATE OF MONTANA

DEPARTMENT OF HIGHWAYS

PRECONSTRUCTION BUREAU

DECEMBER 1974

cover photo: I 15 south of Jefferson City.
The terraces or steps have been formed in decomposed granite and seeded as the cut progressed downward. This technique is more extreme than rough grading or serrating, which is used to hold topsoil. Vegetation was established before the road was opened for travel. The guardrail posts have been stockpiled prior to installation.

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I. INTRODUCTION

This report was prepared by the Montana Department of Highways in response to the directives set forth in SENATE JOINT RESOLUTION 55 of the 1974 Legislative Session. The Senate and House of Representatives jointly resolved:

> "That the Department of Highways is hereby directed to undertake a thorough review and study of highway reseeding practices and policies in Montana, to prepare a report and make recommendations with respect to such practices and policies, and to prepare suggested legislation for the consideration of the governor and the 1975 Legislature. Matters requiring special attention include topsoil conservation and reclamation in connection with all highway projects; exploration of the safety features (or hazards) of borrow pits, exploration of grading of borrow pits from an ecological point of view (studying the best method of minimizing weed invasion and erosion, and possibilities of maximizing productivity); and investigating reseeding practices on county roads and the status of reseeding on such roads, in particular whether the county commissioners are complying with their responsibilities under Section 32-2813, R.C.M. 1947."

Highway rights-of-way are presently being reseeded following construction for several reasons. The most important function

of reseeding is erosion control. Erosion occurs naturally and/or can be man-induced. Natural erosion is a geological process over which man has little or no control; it may be slow or rapid depending on many inter-related factors.

When erosion exceeds the natural rate, becoming unusually destructive, it is called accelerated. Accelerated erosion is caused by two factors: the removal of natural cover, and the exposure of erosive soils. Highway construction by its very nature does remove natural cover and expose erosive soils. In many instances, the exposure of erosive soils cannot be avoided. Disturbed areas can be covered by an erosion-resistant surface, or a protective ground cover can be established.

Protection against erosion provided by vegetation is effected through the binding force of the root system, the dissipation of impact forces by the aerial canopy, and the retardation of runoff and increase in infiltration by the plant stems and root crowns. The structural functionality of the subgrade foundation, shoulders, inslopes, backslopes and drainages can be enhanced for longer periods when erosion is controlled. Thus the integrity of the driving surface can be maintained.

If erosion is controlled or reduced, sedimentation or the deposition of eroded materials is also reduced. Thus the establishment of vegetation cover serves a second inter-related function. National and state concern over an increase in erosion and sedimentation has grown within the last decade. This concern is reflected in water quality legislation that is

giving more consideration to sedimentation.

A third function of reseeding is the improvement of the visual characteristics of completed highways. Recent trends in highway design are complementary to the natural terrain and have greatly improved roadside aesthetics. Cuts and fills, however, are still necessary. Reseeding to establish ground cover in areas previously left bare now produces a positive visual impact.

Figure 1: I 15 Jefferson City North
Building interstate through rough terrain requires large cuts and fills; the lanes are staggered and blended with the natural contour of the land. Natural vegetation has been saved and backslopes have been terraced to aid in slope stabilization and early plant establishment. The old road, (center picture), disturbed less land and did not present the problems of revegetation that modern dual lane highways do.

Figure 2: I 15 Boulder North
Properly designed highways are safer, easier to revegetate, cost less to maintain and have a positive visual impact on the traveler.

Policies and practices of reseeding areas disturbed by highway construction have only recently evolved. The public demand for a functional transportation system has, in part, been met. Environmental considerations, including erosion control, aesthetics and economic priorities, are becoming more prominent in the public view. Engineering principles and construction

practices are changing not only as a result of these new concerns, but also because the "state of the art" is changing. Several years lag must occur before evaluations can be made. Highways builders are now finding that rights-of-way left bare not only cause higher maintenance costs over the life of the highway, but also can become safety problems and eyesores.

Herewith, the statutes governing reseeding of areas disturbed by highway construction are presented chronologically. A historical review of departmental practices and current methods, as they relate to special provisions and construction specifications, are presented pictorially. Comments and legislative recommendations are made for consideration by the Governor and the 1975 Legislature.

II. LEGAL REQUIREMENTS

Prior to 1961, neither the Montana Department of Highways nor the Boards of County Commissioners was under statutory directive to reseed or re-establish sod cover in areas disturbed by road construction. Nevertheless, revegetation efforts were being carried out in scattered areas. Local soil conservation districts,public individuals, and a general public interest in aesthetics and erosion control were motivating forces.

In 1961, the 37th session of the Montana Legislature enacted House Bill 124 as Montana's first highway seeding law entitled:

"AN ACT TO PROVIDE FOR THE SEEDING OF PERENNIAL GRASS COVERS ON NEWLY DISTURBED RIGHT-OF-WAY AREAS, INCLUDING STATE AND FEDERAL HIGHWAYS,

COUNTY ROADS, IRRIGATION DITCHES, DRAIN DITCHES, BORROW PITS, SLOPES, ROAD SHOULDERS OR OTHER TYPES OF CONSTRUCTION; AND PROVIDING A REPEALING CLAUSE."

Section One, as follows, sets forth the duty of the State Highway Commission:

"Whenever a highway, state or federal, is constructed in any part of Montana, it shall be the duty of the state highway commission to see that borrow pits, slopes and road shoulders be seeded to an adaptable perennial grass or combination of perennial grasses and/or legumes wherever it seems suitable for establishment of perennial grass covers using seed meeting certified standards. Time and method of seeding, fertilizing practices and grass species shall be recommended and specified jointly by the Montana extension service, soil conservation service and experiment station. Every effort will be made to establish a sod cover on the newly cut over areas."

Section Two of the act sets forth the duties of county commissioners:

"Whenever the natural sod cover is disturbed on right-of-way for construction of county roadways, irrigation ditches, drain ditches or other types

of construction on such right of way, it shall be the duty of the county commissioners to see that such disturbed areas are seeded to an adaptable perennial grass or combination of perennial grass and/or legumes whenever they believe it is practical to do so, using seed meeting certified standards. Time and method of seeding, fertilizing practices and grass species shall be recommended and specified by the Montana extension service. Every effort will be made to establish a sod cover on the newly cut-over area."

Section Three repeals all conflicting statutes or parts thereof as follows:

"All acts or parts of acts in conflict herewith are hereby repealed."

The 39th Legislature in 1965 re-codified the statutes pertaining to the Montana Department of Highways. In doing so, minor changes were made in the highway seeding statute; however, the intent and applicability remained unchanged.

In 1974, the Legislature directed the Department of Highways by way of House Bill 634 to classify open range areas according to the degree of traffic hazard and fence out livestock in the more hazardous areas. This statute in part amended the highway seeding law so as to include a new section covering seeding and cropping of right-of-way in fenced, open-range areas.

Sections 2412 and 2801 of Title 32, Revised Codes of Montana, 1947, are the present statutes which govern seeding of right-of-way by the Montana Department of Highways and the individual Montana counties:

32-2412 Seeding along highways.

(1) After a federal-aid or state highway is constructed, the department shall seed borrow pits, slopes and shoulders to an adaptable perennial grass or combination of perennial grasses and legumes whenever establishment of perennial grass covers seems suitable. The seed shall be certified.

(2) The department shall seek joint recommendations and specifications as to time and method of seeding, fertilizing practices and grass species from the Montana extension service, the experiment station and the soil conservation service.

(3) After a right-of-way in open range has been fenced, pursuant to 32-2426 or 32-2427 the department may seed the land within the fence to a grass which may be cropped for hay and may lease such lands or sell the right to take such hay to qualified persons.

32-2813 Reseeding of right-of-way areas.

(1) Whenever the natural sod cover on right of way areas is disturbed by construction of county roads, irrigation ditches, or otherwise, the board of county

commissioners shall require that such disturbed areas be seeded to an adaptable perennial grass or combination of perennial grasses and legumes. Every effort shall be made to establish a sod cover on the disturbed area.

(2) All seed used shall meet certified standards.

(3) Time and method of seeding, fertilizing practices and grass species shall be those recommended by the Montana extension service.

In addition to compliance with the statutorial reseeding responsibilities as set forth above, the Montana Department of Highways must satisfactorily meet the regulations of other jurisdictional bodies. The Federal Highway Administration has prescribed policies and procedures for roadside development on Federal aid projects which includes reseeding since the enactment of the Highway Beautification Act of 1965. The United States Forest Service and Bureau of Land Management may also require that specifications and policies on seeding, slope management and grass species be met when highway projects disturb surface under their jurisdiction.

III. HISTORICAL REVIEW

The history of highway reseeding policies and practices in Montana appears to follow three distinct phases. Prior to 1960 highway rights-of-way were not seeded as a general practice following construction. In 1961 the Department of Highways

was required by law to seed rights-of-way. During the next three years, disturbed areas were seeded, but success was marginal. The need for research became very evident. By the mid-sixties the Department's reseeding effort entered its third and present phase, that of research and application.

Pre-1960

Prior to 1960, the Department of Highways had not developed a seeding policy, nor was there any effort made to reseed disturbed areas on a statewide basis. Revegetation, when attempted, was undertaken with initiative at the local level, either by highway maintenance personnel or county road crews. These early, scattered attempts were supervised by individual local Soil Conservation Districts and the U.S. Soil Conservation Service. More often than not, the establishment of ground cover was left to natural plant succession.

Approximately 70 percent of Montana's present rural Primary System had been completed prior to 1960(5). Thus several thousand miles of Montana roadside right-of-way was not reseeded following construction. Many stretches still remain bare or, in some cases where natural conditions were favorable, varying degrees of revegetation have occurred.

In February,1960,the Department awarded its first seeding and mulching contracts. Approximately 145 acres of Interstate right-of-way in the Superior-Alberton and Drummond-Garrison vicinities were to be reseeded in addition to 132 acres near Crow Agency.

The specifications for these two contracts were developed in cooperation with the local Soil Conservation Service offices after reviewing information received from other states and the seed industry. Three additional contracts were awarded during 1960.

These initial reseeding contracts and the appearance of the Interstate system in Montana marked the beginning of a reseeding policy for highway rights-of-way. Within the next year the Department would be required by law to reseed all areas disturbed by construction.

Implementation of a New Law: The Need for Research

Following the enactment of the Montana Highway Seeding Law in 1961, the Department, under a legislative directive to reseed rights-of-way, established a Highway Seeding Committee. The Committee, composed of personnel from the Soil Conservation Service, Montana Agricultural Experiment Station, Montana Extension Service, and Department of Highways, was responsible for recommendations on time and method of seeding, fertilizing practice, and grass species.

During the first several years of the Committee's operation, nineteen seeding contracts were awarded by the Department of Highways. Early results did not meet expectations. Field records on these early reseeding attempts were incomplete, if recorded at all. Information necessary to support and/or revise the Committee's recommendations and departmental field practices was not available. Research was needed to effectively deal with

a wide cross-section of revegetation problems never before encountered during highway construction in Montana.

Research and Application

In 1964, under the guidance of the Seeding Committee, the Department initiated studies, surveys and field research projects to provide the practical working knowledge absent when the seeding law was enacted. Many of these studies and research projects are still underway, providing a continual refinement of revegetation techniques.

Research and implementation of recommendations therefrom has taken time. Results can be observed in two or three years in some instances; other cases take longer. As positive results become available, changes in construction specifications and special provisions are made. Major advancements made between the commencement of research and the present include topsoil salvaging, slope rounding and flattening, a more precise seeding period to coincide with optimum growth factors and geographic locations, variable slope and surface manipulations, two step application of seed-mulch and fertilizer and most recently, stage construction.

Before moving into a discussion of the Department's present revegetation practices, an important point must be made. Not all roadsides can support a dense stand of perennial grass, no matter what reasonable revegetation techniques are used.

Vegetation on each roadside can only reach the state of development possible under the natural environmental conditions

present at the site. Factors which affect the vegetation are: amount and timing of precipitation, texture and fertility of the soil, exposure, elevation, latitude, and length of the growing season. Many roadsides do have less vegetation than would seem desirable, but comparison with vegetation on the other side of the right-of-way fence often shows that the roadside vegetation is similar.

Figure 3: I 15 Boulder North
Many rights-of-way reseeded in the past 10 years have better vegetation cover than do adjacent properties due to protection from over-grazing.

Another point to consider is that not all areas which are inadequately revegetated are causing a serious erosion problem. The Department monitors roadsides for erosion and safety problems. When money is available, the most severe of these areas

are corrected. Financial limitations often perpetuate "eyesores" in favor of correcting more serious problems.

Older roads which are inadequate for today's higher traffic volumes and speeds are being upgraded, as funds become available. This reconstruction will eventually upgrade projects which were built before the Department had a revegetation policy.

IV. CURRENT REVEGETATION PRACTICES

The following discussion outlines the practices and procedures for revegetation currently followed by the Department. The complete specifications may be found in Section 17 of the Standard Specifications for Road and Bridge Construction, as adopted by the Montana Highway Commission and most recently approved by the Federal Highway Administration in October, 1974, and the "Special Provision for Erosion Control, Water Pollution and Siltation Control" (3,4).

Exposure

West and south facing slopes are characteristically more difficult to revegetate and harder to maintain a suitable protective cover.

These slopes being exposed to the direct sun for long periods of time are subject to over heating, high evaporation losses, premature germination, and over-exposure of new seedlings.

Figure 4: I 15 Montana City Exit North, Mile Post 188
East-facing backslope (left mid picture) has responded to topsoiling, seeding and favorable aspect. (Right mid-picture) This section, inadvertently missed during the topsoiling and seeding operations, has not established a suitable cover.

Figure 5: Montana City Exit North, Mile Post 188
This west-facing slope was treated the same as the east facing slope in Figure Four. Vegetation is sparse and will take several years to fill in.

These slopes are seeded first, receive the most topsoil and are mulched quickly after seeding. The seed must be covered immediately after application, even if by hand labor.

Slope Configuration and Erosion Control

Slope shape is a critical factor in establishing a stable soil surface for revegetation. The slopes are made as flat as practical, are rounded at the top and designed to protect the face and toe from flowing water. Slope design also considers the natural contour of the landscape.

Figures 6 and 7: County Roads, Whitewater South, Phillips County
These cuts were made 30 to 40 years ago, leaving backslopes steep, with turf caps that prevent desirable vegetation from establishing.

Figure 8: I 15 Montana City South
Old road cut, upper left, remains bare due to absence of topsoil, steep slope and no seeding. Mid picture: new cut has been rounded, topsoiled and seeded. Inslope has been flattened 6:1, with a wide transition zone to carry away excess water.

Long steep slopes are difficult to revegetate because water tends to flow off instead of percolating in, as it would on flatter ground. To prevent flow of water over the face of the slope, diversion ditches or dikes are constructed at the crest of the slope to divert the water to a central collector, to be transported down a drain and safely off the slope, Figure 9.

Inslopes (the area from the shoulder of the roadway to the bottom of the ditch) are graded to a 6 to 1 (horizontal to vertical) or less slope to keep water from concentrating in a narrow ditch where it could erode the toe of the cut or fill slope. If

these areas are still potentially erosive, they are protected by the use of asphalt or concrete ditch liners, or grass sod, Figures 10, 12. Water velocity is slowed at discharge points by construction of energy dissipators or rip rap, Figure 11.

Figure 9: I 15 Boulder North
Backslope is well rounded with diversion ditch at crest to prevent water flow over the face of the slope. Upper slope face has been drill seeded; the lower has been hydroseeded because of steepness.

Figure 10: I 15 Vaughn North,
Mile Post #295
This median has been protected with a concrete ditch liner and drop inlet which will route water safely off project. Median right of ditch liner was top soiled; left received marginal topsoil.

Figure 11: I 15 Vaugh North,
Mile Post #295
View of drain outlet that has been protected by riprap.

Figure 12: I 15 Boulder North
Where possible, inslopes are graded 6:1 or flatter for safety. The ditch, center, is lined with fiberglass roving and asphalt to eliminate a potential erosion problem.

Topsoiling and Seedbed Preparation

Since 1965, specifications have called for the salvaging and stockpiling of all topsoil and reapplication after the final grading has been completed. This practice has made it practical to seed and establish vegetation on the steeper slopes if the topsoil can be kept in place.

To be effective, topsoil must stay in place. To keep topsoil on a steep slope requires special techniques and proper grading methods. Slopes must be left rough with irregularities or pockets for topsoil to be caught and held. These irregularities can vary from scraper scars to uniform benches or terraces, with horizontal and vertical variations of up to four feet, depending

on the type of soil and the steepness of slope. Rough grading has always been done, but past engineering practices required a final smoothing operation to eliminate what was thought to be an objectional feature. The benches over a period of years will weather to a natural contour. In the meantime, the steps hold the topsoil, trap moisture, and stabilize the slope long enough for vegetation to become established.

Figure 13: I 15 Jefferson City South
This slope has been "mini-benched" or terraced and has responded to revegetation.

Figure 14: I 15 Jefferson City South
This close up shows how mini-benches slough to a natural contour over a period of years; the slope has remained stable long enough for vegetation to become established.

Figure 15: York Road - York Bridge West
Smooth grading will be a thing of the past. All new projects will be rough graded to facilitate holding topsoil.

Figure 16: I 15 Jefferson City South
The far right portion of this slope has been terraced or stepped for stabilization and has started to establish vegetation. The left was smooth graded and has started to slip. Water has rilled the upper portions.

Fills do not require this slope treatment method, but do require special treatments to keep topsoil in place. The subsoil in fills, as opposed to cutslopes, is generally too loose to be a good subbase for topsoiling, and must be compacted as the topsoil is applied. The best method is to apply the topsoil by pushing it into place with a tracked vehicle. The tracks not only compact the topsoil into the sub-base but leave thousands of indentations that trap seed, fertilizer, and mulch.

Fill slopes are easier to revegetate than cut slopes because they are usually flatter, which provides a better substrate

for plant growth.

Figure 17: I 15 Clancy North

Fill slopes respond better to revegetation than do cuts.

Figure 18: I 90 Livingston East
Smooth grading, lack of topsoil and steepness make slopes difficult to revegetate.

The contractor is required to topsoil, prepare the seedbed, seed, and mulch as soon as possible after the final grading. This procedure has several advantages. Loss of topsoil is minimized. Potential for weed invasion is reduced. Additional conditioning of the seedbed is precluded. Erosion is controlled immediately by the protective mulch and the sprouting vegetation.

On recent projects, permanent vegetation is often established several years before the road is opened for use.

Seed

Seed that is purchased for use on the highway must be of high quality and contain no noxious weeds. Seed must meet the standards established by the Montana Department of Agriculture and must be grown under conditions compatible with the area where it will be planted. Preferably, the seed selected should be grown in Montana.

Usually a combination of three species is used in a seeding mixture. The grass species used and the amount of each, are dependent on the type of soil, effective precipitation, elevation, and the desired objective of the seeding.

Most roadside slopes steeper than 3 to 1 are seeded with 24 pounds of seed per acre. Slopes 3 to 1 or flatter are seeded with 12 pounds of seed per acre.

Species that are adapted to eastern Montana are:

"Fairway" crested wheatgrass	Agropyron cristatum
Streambank wheatgrass	Agropyron riparium*
"Critana" Thickspike wheatgrass	Agropyron dasystachym*

Western wheatgrass	Agropyron smithii*
Slender wheatgrass	Agropyron trachycaulum*

The following species are hardy in western Montana or moist areas in eastern Montana:

"Durar" Hard Fescue	Festuca duriuscula
Kentucky Bluegrass	Poa pratensis
Canadian Bluegrass	Poa compressa
"Lincoln" Smooth Brome	Bromus inermis
Western wheatgrass	Agropyron smithii*
"Critana" thickspike wheatgrass	Agropyron dasystachyum*
Green needlegrass	Stipa viridula*

Some of these grasses (those marked by an asterisk) are native to Montana. The others are commonly available exotic species which are widely used in Montana.

It is occasionally suggested that we revegetate with native species only. The major problem with this idea is that there is no commercial seed source for most native species. The Highway Department does have a program to purchase hard-to-get desirable varieties when they are available, and furnishes this seed to the seeding contractors.

Planting Dates

The time of planting is a critical factor and the Highway Seeding Committee has established specific seeding dates. The fall seeding season starts October 15th and ends when snow covers the ground or the ground is frozen. The spring seeding season

starts as soon as the ground is dry enough to permit equipment to traverse the seedbed or when the frost has left the ground if the area is to be hydroseeded. It ends April 30th in the dryer eastern portion of the state and May 20th in the intermountain region.

Timing of fall plantings is critical because the seed should not germinate until spring. Germination in the fall may result in the death of many seedlings if cold weather arrives before they become well established.

Planting in early spring gives the best results. To be successful, the seed must be placed in the soil early to allow germination and development of a vigorous plant with a large root system before the available moisture is depleted during the summer dry spell. If soil moisture becomes limited at any time during the development of the seedling, the plant will perish. To guarantee seedling establishment in eastern Montana during a normal year, the spring seeding must be completed by late April. A major disadvantage to seeding in the spring is the short period of favorable seeding time and the adverse working conditions normally encountered. After the soil becomes dry enough to work, the spring rains usually commence, thereby preventing seeding operations.

The seeding dates can be modified on a case to case basis by the Department's staff agronomist, but usually if this is done the contractor must have provisions for supplemental watering during critical periods of plant growth.

Fertilizer

The handling of fertilizer, especially nitrogen fertilizer for dryland plant establishment, is critical. Application of too much fertilizer at the time of seeding may benefit annual weeds at the expense of the grass seedlings. Too much fertilizer can over-stimulate growth in seedlings, or may "burn" the seedlings. High concentrations of nitrogen can reduce the percent of germination, if in contact with the seed for over 1 hour. Nitrogen fertilizer can be leached from the soil before the seedlings are mature enough to utilize the fertilizer effectively.

To avoid these problems, the timing, rate, and method of application must be accomplished with great care and by qualified personnel. Present practice is to apply the fertilizer at a rate well below the critical level at the seeding stage. With this method, the seedlings receive some benefit, but are protected from burning, and reduced germination. The weed problem is also reduced and leaching of nitrogen is minimized. The Department programs the bulk of the fertilizer to be applied over a period of years following seedling establishment. The mature plants are better able to use the fertilizer and respond much more favorably than if fertilizer was applied only at the seeding stage.

Mulches

From the time the soil is first exposed until a permanent cover of vegetation is established, the soil is subject to erosion by wind and water, and baking by the sun which causes

the soil to crust and reduces the moisture content. These conditions are not favorable for germination and development of desirable plants. Mulches are used to mitigate these problems.

When properly selected and applied, mulches not only protect the soil from erosion but provide a microclimate conducive for establishment of plants. Mulches hold seed in place until it can germinate, provide shade for tender seedlings, moderate temperature extremes of the soil, increase the infiltration rate of moisture, inhibit evaporation, and reduce compaction of the soil by heavy rains.

The Department uses two basic types of mulches, straw and wood fiber. The type and amount of mulch selected for a particular job depend on the type of soil, percent of slope, and conditions of climate.

Straw or native hay held in place with a light coating of asphalt is used in dry areas and areas where the soil is subject to freezing and thawing which causes the soil to heave. This mulch flexes with the soil and remains in place.

There are several disadvantages to straw and asphalt mulch. The cost of asphalt is rising with the shortage of oil. Availability of asphalt is seasonal, being dependent on road construction which ends with the arrival of cold weather. This type of mulch is the more difficult to apply. And finally, long slopes must be accessible from both top and bottom because straw cannot be blown a long distance.

Wood fiber mulch is used in high wind areas where straw would be displaced. Wood fiber mulch is a specially prepared product consisting of wood fibers of varying length which forms an interlocking mat when properly applied. The mat is stable in the wind, but is not dense enough to retard emergence of seedlings or percolation of water into the soil. Wood fiber mulch can be applied to longer slopes than straw-asphalt mulch because it can be blown farther. Additional benefits are that it requires less equipment to apply, it is less messy, it is available year around, and can be used in cold weather without special heating apparatus (asphalt must be heated in cold weather). A disadvantage is that it tends to absorb moisture from the soil (straw does not). This limits its use to areas with fairly high rainfall.

In some instances, the results achieved with wood fiber mulch were less impressive than when straw and asphalt were used. This was because seed was applied with the wood fiber mulch. As a result, some seed became suspended in the mulch and was blown away or kept from contacting the soil. This problem is discussed more fully in the section on seeding methods.

When a project is completed during the summer or is in a high wind area, the Department has developed a temporary erosion control method to protect these areas until conditions are optimum for establishment of plants. Straw or native hay is applied at a rate of one to one and a half tons per acre over a cultivated seedbed. The straw is incorporated into the soil by a special mulch tiller which punches the straw into the soil to a depth of 3 inches,

leaving half the stems above ground in uniform rows. The resulting stubble will trap snow, reduce runoff, and check erosion by wind. When conditions are suitable, seed can be applied through the anchored straw with a disc drill without any loss of protection from the stubble. No additional preparation of the seedbed is usually needed. A disadvantage of straw anchored mulch is that slopes 3 to 1 or steeper cannot be worked. Research is underway to develop a machine to operate on steep slopes.

Seeding Methods

Most areas flat enough for safe operation of machinery are seeded with a drill. Exceptions are small areas such as around slope drains and bridge ends, which are broadcast seeded. At the present time, drilling is the most successful method of seeding.

Drills equipped with press wheels place the seed in the ground at the correct depth and then compact the soil around the seed. The former helps to insure maximum establishment of seedlings, the latter prevents moisture from evaporating from the soil before germination.

Department specifications recommend that grass drills, equipped with fertilizer attachments and press wheels be used. If this type is not available, a grain drill can be substituted if converted for use with grass seed.

No mulch is required with drilling unless the soil is sandy and high loss of moisture would occur otherwise.

Unfortunately, not all areas can be drilled. The only practical method of seeding slopes 3 to 1 or steeper is the hydroseeding method.

Figure 19: I 15 Boulder North
The steep lower slope which was hydroseeded has not established as dense a vegetation stand as the upper area that was drilled.

The best results are obtained when a two or three step method is used. The seed is applied to the prepared slope using water as a carrier. Then, if the slope is not excessively steep or inaccessable, the seed is covered to a depth of 1/2 to 3/4 inch with soil. Finally, a mulch may be applied. This method insures that the seed will not be lost before conditions are suitable for growth.

In the past, seed, fertilizer and wood fiber mulch were applied in slurry form in a one-step hydroseeding process. Experience has shown that the heavier, water-soaked mulch reached the soil first. The lighter seed was on top of or suspended in the mulch, and never contacted the soil. Partially exposed seed was subject to being blown away by wind or carried away by flowing water. Results with this one-step method were often not satisfactory so it is no longer used.

Stage Construction

Until recently, highway revegetation programs were expected to establish permanent ground cover with one seeding operation. No money was allocated for additional work on jobs that were partial or complete failures.

Most jobs have some areas which could use some touch-up work. In these cases, stands of grass can be brought up to an effective vegetation cover by additional fertilization and/or seeding, or by mechanical protection from erosion.

In 1974, the Department instituted a stage construction program for revegetation which allows for reseeding,

refertilization, remulching, and/or erosion protection for areas which did not respond satisfactorily to the initial attempt. This procedure applies to all projects let after April, 1974.

V. MAXIMIZING PRODUCTIVITY ON HIGHWAY RIGHTS-OF-WAY

In addition to the normal functions of highway right-of-way, two uses have been suggested to maximize productivity: growing agricultural crops and managing for wildlife.

Highway Department procedure requires that a rancher interested in having or otherwise utilizing a portion of state controlled right-of-way apply for an agricultural use permit from the appropriate Divisional Chief of the Field Maintenance Bureau. Such permits are granted if no conflict would exist with a more important function of the roadside. An application for a permit may be turned down for several reasons.

A major function of the roadside is to provide a reasonably safe area for a vehicle leaving the roadway surface to come to rest. If the agricultural activity would cause undue hazard to the road user, the permit may be denied. If the permitee operates his machinery in such a manner that highway traffic has to continually slow down or swerve suddenly to avoid a collision, the permit may not be renewed. In general, safety problems would tend to be most severe on roads serving high speed, high density traffic.

Another function of right-of-way is to provide a suitable substrate for the roadway. An agricultural use permit would not

be granted if the activity would endanger the roadway.

Aesthetic considerations may also influence granting a permit. If the roadway has been specifically engineered or landscaped to provide a pleasing visual aspect, agricultural activities may not be compatible.

Occasionally, more right-of-way is purchased than is necessary for immediate construction. This is done when the need for additional construction in the future is evident. In such cases, the excess right-of-way may be used in its previous manner until it is required for construction.

The second method of maximizing productivity is to manage rights-of-way for wildlife. The point has been well made that highway, railroad, and utility rights-of-way cover very extensive acreages (6,7). Many species of animals can use this land for at least a portion of their habitat.

Several studies have examined the effects of roadside mowing and special plantings on ring-necked pheasant and duck nesting success (1, 2, 6). It was shown that planting suitable cover and regulation of mowing practices can produce significant increases in game bird populations. Other animal populations also benefit.

Mowing practices of the Montana Department of Highways generally conform to published suggestions for maximizing cover for wildlife. No experimentation with special plantings to provide cover has been done because we have had no indication that there is a problem with the species presently planted.

Conflict may arise between use of rights-of-way for agriculture and wildlife habitat. The sections of rights-of-way which could be managed most beneficially for game birds are the areas which traverse intensively cultivated regions. In such areas, nesting and wintering cover is at a premium. This is one of the major reasons why pheasant populations, in particular, have declined. Demand for additional cultivatable land in these areas, including use of highway rights-of-way, is often high.

The Department of Fish and Game has discussed with the Department the possibility of managing such critical areas for game birds. To date, these critical areas have not been defined by their Regional Game Managers, so no further actions have been discussed or taken.

VI. BORROW PIT DESIGN

Roads are built on grades which are elevated above the level of the adjacent land to minimize drifting of snow, and to provide a compacted base for the roadway surface. Extra material must be appropriated from somewhere to build an elevated roadway.

Prior to 1960, this material was borrowed as close to the roadway as possible to minimize cost of right-of-way and to simplify transportation of the material. This type of construction left deep borrow pits with steep backslopes, which were very hazardous to out of control vehicles. About 70 percent of

Montana's present rural Primary System and most of the county roads were built in this manner.

Figure 20: County Road, Whitewater North
The steep inslope, deep borrow area and sharp banks are doubly dangerous; the vegetation partially screens these hazards on this older county road.

Figure 21: County Road, Whitewater North
The grades are normally built high to blow free of snow; this section is being regraded, thus removing hazardous backslopes (left center).

Since 1960, borrow pits have been built with inslopes graded 6 to 1 and the backslopes 3 to 1, wherever possible. This technique provides a less hazardous pathway for out-of-control vehicles, though the amount of right-of-way necessary for construction is greater.

This borrow pit design is used for all new projects, many of which are upgradings of old roads. In this manner, the unsafe borrow pits are gradually being eliminated, especially along state roads. County roads are being improved more slowly due to more limited availability of funds and lower traffic volumes.

VII. COUNTY RESPONSIBILITIES

Under state law the Boards of County Commissioners have the responsibility for selecting, planning, constructing and maintaining county roads. The Commissioners are also responsible for reseeding and establishing a permanent sod cover on all areas disturbed by county construction. Most recent county projects have been successfully revegetated. As in the case of state roads, a high percentage of the county roads were completed prior to mandatory reseeding. Some of these were revegetated through efforts at the local level, by natural means, while others remain unrevegetated.

VIII. RECOMMENDED LEGISLATION

The Montana Department is not requesting new legislation pertaining to seeding along highways. The Department finds that the present statute, while requiring the establishment of cover

on disturbed areas, is not so restrictive in that the flexibility necessary to handle a wide cross-section of conditions is lost. Construction specifications and special provision can be changed to reflect recent research developments and case by case problems while still satisfying the legislative intent.

However, a minor amendment could be instituted to clear up an interpretation problem regarding certification of seed. Section 2412 and 2814 of Title 32, R.C.M. (1947), call for seed meeting certified standards, and certified seed, respectively. Because of the various interpretations of "certified" or "certified standards," the Department feels that certifying agency should be defined as the Montana Department of Agriculture. The certifying agency should certify only the quality and purity (free of weed seeds).

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